CHEMICAL & ENGINEERING NEWS

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C&EN

OCTOBER 5, 1992

ELECTION PRESAGES BIG CHANGES FOR SCIENCE IN CONGRESS PAGE 50

RESPONSIBLE CARE

Program to improve environmental performance challenges chemical makers
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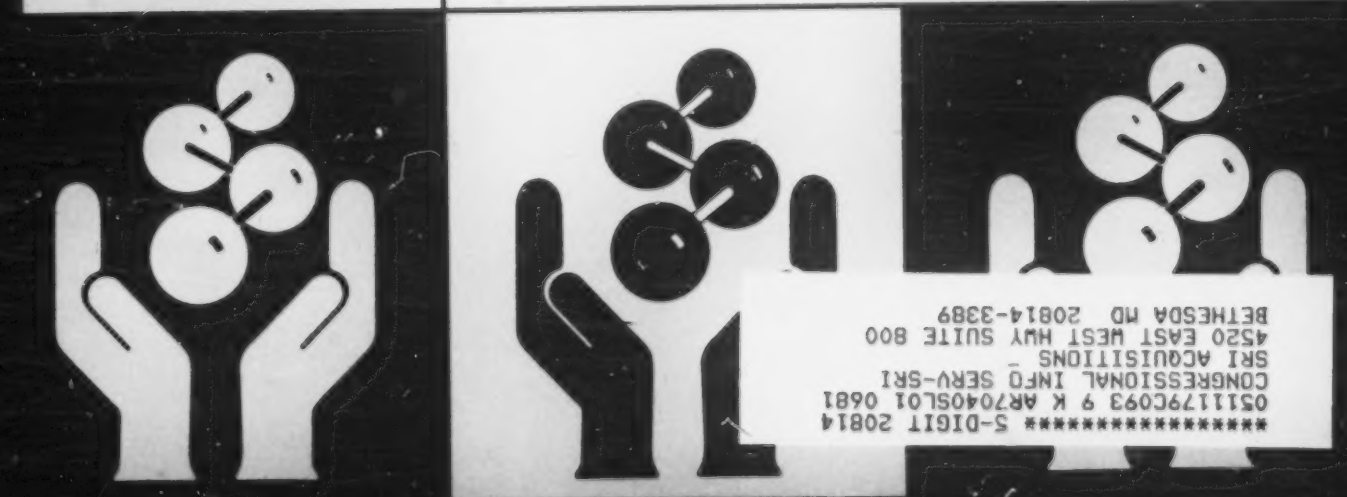

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CHEMICAL & ENGINEERING NEWS

C&EN

OCTOBER 5, 1992

NEWS OF THE WEEK

- EPA pulls proposed hazardous waste regulations that would have changed the way industry manages such waste; critics allege the move was politically motivated. Page 6
- U.S. launches Mars Observer spacecraft to explore the Red Planet's atmosphere, surface, interior, and magnetic field. Page 7
- Ozone destruction over Antarctica this year has appeared earlier, extended to lower altitudes, and covers a wider area than ever before. Page 7
- U.S. complacency about education needs to be shaken so continued progress can be made toward National Education Goals set by President Bush and state governors. Page 8

BUSINESS

Air Products is coming close to achieving the goals of its long-range strategic plan, although its new chairman does see the need for changes in some areas. Page 44

Japanese chemical firms are tightening their management of technology in an effort to remain competitive with their U.S. and European counterparts in the coming years. Page 46

Biotech industry had record revenues of $8 billion but incurred a net loss of $3.4 billion for the year ending June 30, according to a recent study. Page 48

GOVERNMENT

Heavy turnover is expected in Congress following next month's election, triggering major changes in many committees whose actions affect the chemical community. Page 50

New missions for three Department of Energy laboratories in a changing domestic and international economy are the focus of House debate. Page 54

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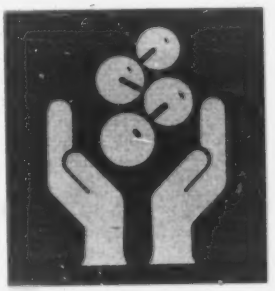
Researchers have bridged the blood-brain barrier by using a molecular packaging technique that enables "targetor"-peptide-cholesterol conjugates to slip past it. Page 57

Computational chemists are aiming to determine how best to integrate computer-aided techniques into the drug discovery process. Page 59

EDUCATION

Burke Laboratory, Dartmouth College's new chemistry building, has computer stations in both teaching and research labs and is designed to encourage faculty-student interaction. Page 59

NEWS FOCUS



Chemical Manufacturers Association's Responsible Care program spearheads efforts to improve chemical industry's environmental, safety, and health performance to renew the public's trust. Page 13

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LETTERS

CHEMICAL SAFETY

Autoclave explosion results in injury

Wet-air oxidation of sodium zinc cyanide at 6000 ppm was carried out in a titanium autoclave tested to withstand 100 atm. The autoclave was heated to 200 °C. Seventy-five milliliters of the cyanide compound was injected into the autoclave with oxygen. Three such oxidations were successfully made at 200 °C and oxygen partial pressure of 3 atm. On the fourth such run, 11 minutes into the run, a violent explosion occurred. The gas-reactant valve had partly melted and fragmented. This valve was also made of titanium.

In a similar experiment with a similar autoclave, 100 ppm of 2,5-xylenol was tested at 180 °C and oxygen partial pressure of 4 atm. While adjusting the gas-reactant valve five minutes into the run, an explosion occurred where the SS-316 100-mL cylinder (meant for injection of the compound solution) was connected to the titanium gas-reactant inlet valve, producing third-degree burns over 40% of my body.

This disaster occurred while I was working on my doctoral project in the Bombay University department of chemical technology. No reference to similar hazards could be located in the literature.

V. R. Shenoy
Bombay, India

Chemical sensitivity, aversion

I am writing to add a few thoughts to the recent comments on multiple chemical sensitivity syndrome (C&EN, Jan. 20, page 3) and to draw a parallel between it and the acquired taste aversion phenomenon.

Acquired taste aversion has become recognized during the past 10 to 20 years. In general, it involves the development of an aversion to a foodstuff to which an organism has been exposed, even coincidentally, during an episode of ingestion-related trauma. Although the classic example of the phenomenon is the bait-avoidance behavior of rodents who have previously been sickened by poisoned bait, we are all aware of anecdotal reports of analogous responses by humans. Acquired taste aversions appear to have a significant physiological component; that is, they do not appear to depend on a conscious memory of the event, and they tend to lessen with time.

The credible, nonemotional reports of the multiple chemical sensitivity syndrome contain some interesting similarities. It is not a congenital problem and it, therefore, can be considered to be acquired at some point in life. It has been reported to have been caused by a triggering event involving an abnormal or excessive exposure to toxic materials through such events as chemotherapy, accidental pesticide exposure, or industrial chemical exposure, for example. Finally, the syndrome appears to ameliorate, with time, permitting victims to tolerate normal levels of odor.

I would like to encourage the chemical community to adopt a policy of referring to the syndrome as an acquired smell aversion or an acquired odor aversion. This would, in effect, replace the term multiple chemical sensitivity, with its implication of a physical illness caused by chemicals, with a considerably less pejorative name. The term aversion implies much more a psychological or psychosomatic condition rather than one that is physiological. We would also avoid the inaccurate relating of the syndrome to an allergic reaction as implied by the term sensitivity. The use and promulgation of the acquired aversion descriptor would permit sympathetic discussions with alleged victims while emphasizing that the phenomenon is an idiosyncratic response. I present these thoughts to help the chemical profession develop strategies to contend with this issue.

Fred W. Stone
Firmenich Inc.
Princeton, N.J.

International study

I applaud the recommendations made by ACS president Ernest Eliel (C&EN, Aug. 10, page 31) that ACS encourage and facilitate long-term visits to foreign countries by American chemistry students. I wholeheartedly agree that the possibilities

Continued on page 79

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municipality, or company that the plant will serve.

However, the company's environment and energy business continues to register a loss. In 1991, the operating loss for the unit totaled $7.2 million. And this continued through the first nine months of the current fiscal year, when environment and energy had an operating loss of $3.9 million.

Wagner says he is not dissatisfied with the unit's performance. Some markets, such as flue gas desulfurization, are growing slower than anticipated. But others, such as cogeneration, are moving faster. And, he says, as for the operating losses, these are all highly leveraged joint ventures and the interest charges are included in the operating results, lowering operating earnings.

Thus far, Air Products and its partners have invested more than $1.2 billion in six waste-to-energy, cogeneration, and flue gas desulfurization projects. All six are performing better than environmental standards call for, according to Wagner.

Wagner says his biggest challenge upon assuming the chairmanship is to continue the momentum that has been initiated under his predecessors. This includes globalizing the business, especially in the Far East and in Latin America and Canada; continuing to implement the goals of the strategic plan; expanding applications for both industrial gases and chemicals; and making the environment and energy segment a bigger contributor to the company.

Wagner does say, however, that there are some areas—mainly cultural—that, although he does not want to change them, he at least wants to broaden them. Although he considers the company a leader in safety, he believes there is a need for a greater commitment and sensitivity to the environment. In this area, he says, "we can do better."

He also thinks the employee population of Air Products needs to be diversified so that "employees will be similar to the world around them. This will mean a shift from primarily white male engineers to a broader spectrum—men, women, people from all cultures." A diverse employee population that is accustomed to working together in the U.S., he adds, also will be more effective in working with the different cultures in the other countries in which Air Products operates. "This is not a radical shift, but it is building on a culture that is already there," he says.

And he sees a need for more empowerment of employees—letting employees make more strategic decisions on their own. "We need to flatten our organization so that it is more responsive to the marketplaces that we are in," he says.

Wagner says these changes mainly come under the company's quality initiative and are largely cultural in nature. On the business front, there are few areas that he wants to alter. "From a business standpoint we have plenty on our plate," he says. "I see no need to look for dramatically different businesses. We like being in the position of having more opportunities than resources. It forces us to order our priorities and make better decisions." □

Japanese firms emphasize technology management

Of long-range strategies Japanese chemical companies are adopting to remain competitive in the 21st century, a beefed-up research and development effort ranks high on the list.

But implementing that strategy won't be easy for them. Smaller than many of the Western chemical companies with whom they compete, Japanese chemical companies have fewer dollars to spend on R&D. As a result, they will have to manage their technology more effectively, not just in the lab, but also along the entire chain from idea to marketplace.

Some signs indicate that they already are starting to do this. Shigeyoshi Takaoka, executive vice president of Kansai Research Institute, Tokyo, says Japan's chemical industry is accelerating its pace of innovation. He told the recent 2nd World Chemical Congress in Newport Beach, Calif., that most of its top executives understand clearly that the future growth of their companies—even their survival—depends on how well they can commercialize new products and processes based on their own R&D.

Among the technologies that he expects to emerge in the late 1990s and beyond are new materials, microelectronics, and biotechnology. Industries based on these technologies will grow much faster than gross national product and will be the driving force of world economic growth.

In Japan, for instance, Takaoka says such industries will account for 15 to 20% of GNP by the end of the 20th century. Advanced technological industries had only a 2% share of Japan's GNP in 1980.

However, for Japanese chemical companies to participate in this growth, they will have to use their limited R&D funds more effectively, he points out. Compared with U.S. and European chemical companies, or even with Japanese companies in other industries, each Japanese chemical company has less R&D money available.

That's because they are much smaller than their U.S. or European counterparts. Sales of Asahi Chemical, the largest chemical company in Japan, are only one fourth those of Germany's Hoechst and one third those of the U.S.'s Dow Chemical. Its net profit is only a fourth as large as Hoechst's or Dow's. Asahi's R&D spending ranges from 25 to 33% of its giant competitors.

Because there are so many small chemical companies in Japan, competition among them is keen. Price wars are common, and profits are lower than they are for U.S. and European chemical companies.

Takaoka notes that in the U.S., the top five chemical companies control 53% of their domestic market. In Germany, the top three command 70% of the market. But in Japan, it takes the top 10 companies to corral only 37% of the market. "There is no price leader in Japan to secure a reasonable profit for the industry," says Takaoka.

Japanese chemical companies do not export as much or produce as much overseas as their Western counterparts. Nor are they as diversified as Western companies, which have branched out into energy, pharmaceuticals, paints, and electronics. This leaves them more vulnerable to recession.

Among Japanese companies, Asahi "seems to be" the most diversified, says Takaoka. Of its 1991 sales ($7.2 billion), chemicals and plastics accounted for 38% and housing for 36%, with the remainder divided among fibers, pharmaceuticals, food, and others.

Today, Japanese chemical companies spend an average 4.9% of sales on R&D. Their R&D staffs average about 9% of total employees. Thus, R&D spending in the Japanese chemical industry is less than in the West, not only as a percent-

Chemical companies have ambitious plans for 21st century

$ Billions[a]	2001 sales target	Goal	Major strategies
Asahi Chemical	$24.6	Fifth largest in the world	Diversification into biotechnology, pharmaceuticals, functional products
Mitsubishi Chemical	$16.4	10th largest in the world, with 50% of sales from functional products	Information, electronics, new materials, pharmaceuticals, organic fine chemicals
Sumitomo Chemical	$17.2	International sales 30% of total	60% from specialty chemicals
Mitsubishi Petrochemical	$ 8.2	50% of sales from other than commodity chemicals	Fine chemicals, biotechnology, agrochemicals, new materials, new polymers
Mitsui Petrochemical	$ 4.1	Integrated chemical company, with 50% of sales from specialty chemicals	Agrochemicals, biotechnology, fine chemicals, optoelectronics, optical disks
Nippon Shokubai	$ 2.5	$655 million sales from new areas	New processes based on innovative technologies, information storage, optoelectronics, environment, fine ceramics, biotechnology

a Converted from yen at current exchange rates. **Source:** Kansai Research Institute

age of sales, but on an absolute basis as well.

Takaoka believes that all of these traits tend to make current research in the Japanese chemical industry inefficient. Of total R&D expenditures in the Japanese chemical industry, the top five companies combined spent 17.4% in 1986, whereas the German top three companies spent 67.4% and the top three chemical companies in the U.S. spent 25%.

What this means, says Takaoka, is that in Japan, R&D money is widely—and thinly—distributed among many small companies. It also means that the same kind of research probably is being done by many companies without each other knowing it. As a result, says Takaoka, Japanese chemical companies are wasting a lot of research money that they can't afford to waste.

That's why they are working hard to tighten up their management of technology as they make their long-range plans for the 21st century. These plans include not only more intensive R&D, but also globalization and diversification into such areas as specialty chemicals, electronics, biotechnology, pharmaceuticals, and optoelectronics.

To Takaoka, technology management means managing the entire chain of events, from idea to point of sale. "It is the way to get the largest profits from products with the least input of human and monetary resources," he says.

The job of managing technology starts with managing ideas. In the Japanese chemical industry, "need-oriented" ideas that flow from the marketplace are more important than "seed-oriented" ideas generated by research staffs.

Asahi Glass, for instance, has a market development center in each business division. Each center is staffed with about 30 professionals, consisting of about 70% technical and 30% marketing and sales people. The team feeds ideas obtained from the market back to each development center.

Takaoka also believes that the Japanese chemical industry tends to take on too many research projects. As a result, researchers and R&D dollars are so thinly distributed throughout the industry that the research can't possibly be very productive.

He says that too often in the past R&D ideas were decided not on their merit, but by the "egos and superficial perceptions" of top executives and research management. But now that R&D funds are becoming a larger part of their budgets, Japanese chemical companies are becoming much more selective in allocating R&D funds to new projects.

To reduce risk, many companies join projects sponsored by Japan's Agency of Industrial Science & Technology, which is part of the Ministry of International Trade & Industry. For chemical companies, two of its projects are most important. One is the National Research & Development Program, known as the "large-scale project." The other is the R&D Project on Basic Technologies for Future Industries, popularly known as the "Jiseidai project." In addition, about 30% of all Japanese companies work with national and public institutions, whereas 76% of them team up with universities.

To reduce time and money spent in applied research, many Japanese companies are automating their laboratories. And because most R&D efforts of Japanese chemical companies are market, or "needs," oriented, they tend to work closely with potential customers and suppliers at this stage of the development effort. About 45% of Japanese companies, says Takaoka, work with other Japanese companies.

After the applied research is completed, plant research or engineering personnel team up with the laboratory research staff to do the pilot-plant testing and development. In Japan, there is a close relationship between the two staffs.

In fact, Japanese chemical companies frequently rotate their development and plant staffs. Traditionally, says Takaoka, Japanese companies consider production technology to be critically important. And one of their strengths is that cooperation between the development group and production group is very smooth and "superior."

However, even if a company develops an idea this far, it won't be a success until the product is sold in large enough volumes to generate reasonable profits. To be successful in marketing and sales, Japanese chemical companies are taking several approaches. Some companies are making strategic alliances with other companies, including foreign companies, to take advantage of both of their strengths.

Others are adapting different tactics. Sanyo Chemical, for instance, has its "spin-off" system. So far, it has set up six spin-off companies as independent organizations to develop new businesses quickly and efficiently.

Sanyo's basic criteria for setting up a spin-off company is that the product must have a promising future and that the business cannot be managed effectively under the parent company's tra-

ditional management umbrella. The sales target for a spin-off company is 5 billion yen in five to seven years after startup. That's about $40 million at present exchange rates.

Sanyo's six current spin-off companies are in adhesives, health and medical products, functional polymers, imports, reactive resins, and optoelectronics. Typically, a spin-off company is staffed with 30 people from all of Sanyo's divisions, including R&D, production, and sales.

These companies are given full autonomy and responsibility for their own profit—and loss. Sanyo says that this arrangement shortens the time needed to develop and market a product and is better suited to training a staff. Because each spin-off company is small, it is more nimble than the parent. It can solve problems more quickly and effectively.

Toray, on the other hand, has a "new business" division that was started in 1971. Six business units are operating within it: carbon fibers, systems equipment, medical products, printing plates, pharmaceuticals, and optical products. In addition, Toray has a "new business promotion" unit that handles smaller volumes of new products.

The products that the new business division handles are developed by the R&D division and produced by the production division. Thus, the new business division concentrates on marketing and selling Toray's new products.

About 900 people work in the division, including about 250 in marketing. Each business unit within the division is responsible for its own financial performance.

Regardless of how it is done, top executives of Japan's chemical companies realize that properly managing technology is the key to their future growth, if not their very survival, says Takaoka. And now that they realize it, the philosophy and attitude of these top executives will play a big role in determining whether or not their companies' management of technology will eventually pay off on the bottom line.

Earl Anderson

Biotech industry revenues top $8 billion

The biotechnology industry continues to show tremendous growth and change, according to New York City-based professional services firm Ernst & Young's annual report on the biotechnology industry, "Biotech '93: Accelerating Commercialization." Revenues grew 28% and reached an all-time high of more than $8 billion for the year ending June 30, the report says. Product sales grew 35% and reached nearly $6 billion. However, sales still are attributable mostly to a few major products from a handful of top-tier companies. Overall, the 1231 companies surveyed reported a combined loss of $3.4 billion, an increase of 32% over the previous 12 months.

Whereas last year's Ernst & Young report focused on biotechnology's promises becoming realities, this year's report stresses that the industry is getting a "dose of reality." Uncertainties are higher than ever in the manner of volatile capital markets, patent disputes, regulatory issues and delays, and pending health care legislation. Yet, on the positive side, the federal government's stand on genetically engineered foods is expected to open the gates for agricultural biotechnology companies.

"Macrotrends" are becoming more important in determining the direction of the industry, than "microevents," or isolated company events, which often distract attention, says G. Steven Burrill, national director for Ernst & Young's San Francisco-based high-technology industry services. In response, he adds, executives are developing creative strategies to accelerate commercialization. To put these strategies into effect, companies have record amounts of capital to support growth and development.

During an 18-month public financing window that encompassed 1991 and the first half of 1992, 131 companies raised a record $5 billion through initial and followup offerings. In comparison, $3 billion was raised by companies during the decade of the 1980s. The financing window has since closed with stock prices falling precipitously in mid-1992.

Despite this, the market capitalization for the biotechnology industry remains at about $50 billion, up from $35 billion last year, but down from a midyear high of about $60 billion. A recovery in the financial markets is not expected for at least six months, says Burrill, and more likely not until the summer of 1993. But between $500 million and $1 billion in venture capital may be available for startup companies, because investors raised new funds during the stock market's earlier highs.

Another important factor this year, highlighted by the Presidential election, is the effect of politics on the industry, says Kenneth B. Lee, national director for life sciences industry services at Ernst & Young. The dialogue around major issues of health care reform and funding, the U.S. federal deficit, research funding, the role and effectiveness of regulators, tax initiatives such as capital gains, and international trade has a dramatic, and until resolved, uncertain effect on biotechnology.

Ann Thayer

Industry shows overall growth despite net loss

	Public companies			Industry total		
	1991–92	1990–91	% change	1991–92	1990–91	% change
Product sales ($ billions)	$ 3.4	$ 2.6	31%	$ 5.9	$ 4.4	35%
Revenues ($ billions)	$ 4.5	$ 3.5	29	$ 8.1	$ 6.3	28
R&D spending ($ billions)	$ 2.3	$ 1.5	54	$ 4.9	$ 3.4	42
Net loss ($ billions)	$–1.4	$–0.9	60	$–3.4	$–2.6	32
Stockholders' equity ($ billions)	$ 8.2	$ 4.5	83	$13.6	$10.7	27
Number of companies	225	194	16	1,231	1,107	11
Number of employees	37,000	33,000	12	79,000	70,000	13

Note: Fiscal years ending in June. **Source:** Ernst & Young